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MSS60 Engine Management System

Initial Print Date: 1/08 Revision Date:

MSS60 Engine Management System

Model: E90 M3, E92 M3

Production: 2/2008

OBJECTIVES

After completion of this module you will be able to:

- Identify the digital motor electronics control module version
- Identify the improvements made to the ionic current monitoring system
- Identify and explain the purpose of the components used in the fuel system
- Identify and explain the purpose of the components used in the cooling system

MSS60 Engine Control System

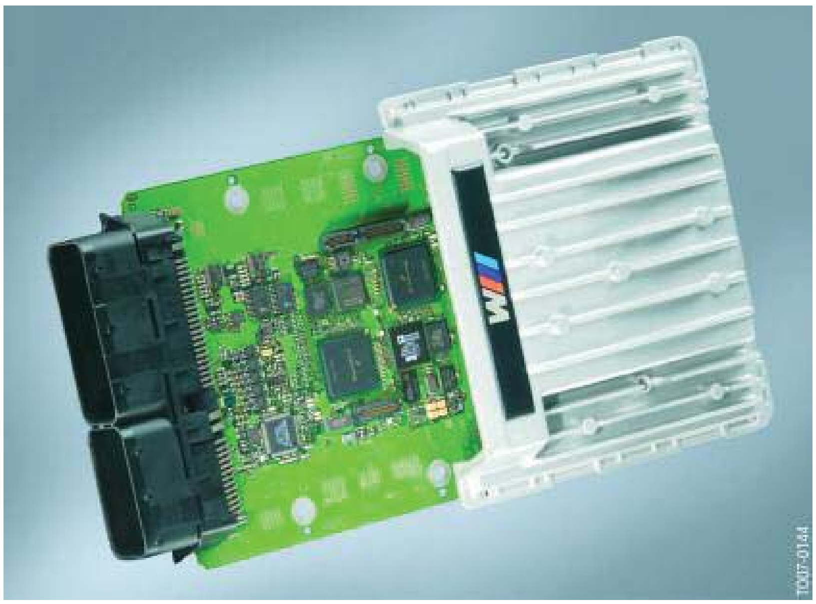
The S65 features a revised engine control system, the MSS60, which is based on the MSS65 in the S85 engine.

This engine control system is designed for engine speeds of up to 9,000 rpm.

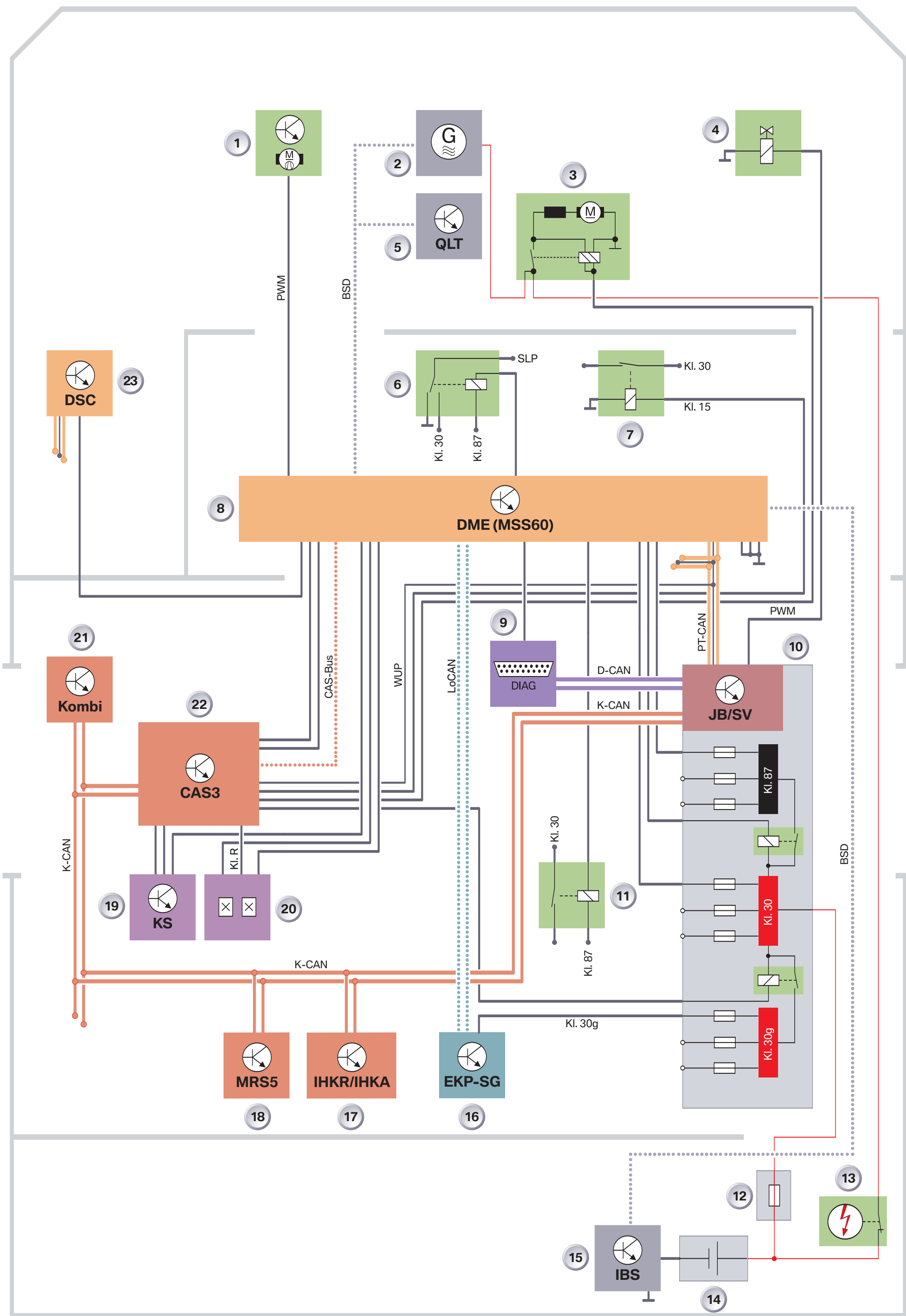
These engine control units belong to the latest generation and are characterized by an extremely high data processing capability, processing millions of calculations per second.

The main functions are described in the product information for the E60 M5.

The following is a description of the areas of the system that differ from the MSS65.



On-Board Connection



Index for On-Board Connection

Index	Explanation
1	Electrical cooling fan
2	Alternator
3	Starter
4	Control valve in the air conditioning compressor
5	Oil condition sensor
6	Secondary air pump relay
7	Injection nozzle supply relay
8	Engine control unit MSS60
9	OBD2 diagnosis connector (TD output from MSS60 and D-CAN to JB)
10	Junction box (JB) and distribution box (SV)
11	Evacuating pump relay for brake servo action
12	High-current circuit breaker (250 A)
13	Safety battery terminal (SBK)
14	AGM battery.
15	Intelligent battery sensor (IBS)
16	Electric fuel pump control unit
17	IHKR/IHKA control unit
18	Multiple restraint system (MRS5)
19	Clutch module (KS)
20	Brake light switching module
21	Instrument cluster
22	Car Access System (CAS3)
23	Dynamic Stability Control (DSC)

Ion Current Combustion Monitoring

The ion current combustion monitoring is also used in the MSS60 for knock identification and misfiring identification. In principle, the method of action is identical to the S85 and its MSS65.

The S85 has two ion current monitoring devices, each of which covers a whole cylinder bank. In the S65, the electronic ion current system is integrated into each ignition coil and the ion current monitoring devices are not required.

During ignition, the measurement current is stored in a capacitor integrated in the ignition coil, and after ignition, is available at the spark plug electrode. In the S65, the ion current measurement and evaluation is also performed exclusively by the MSS60.

The functional range of the ion current electronics has been further refined. There is no longer a need for two measurement control lines, and the ignition current and the ion current measurement signal have been combined into a single transmission route (separate in the S85).

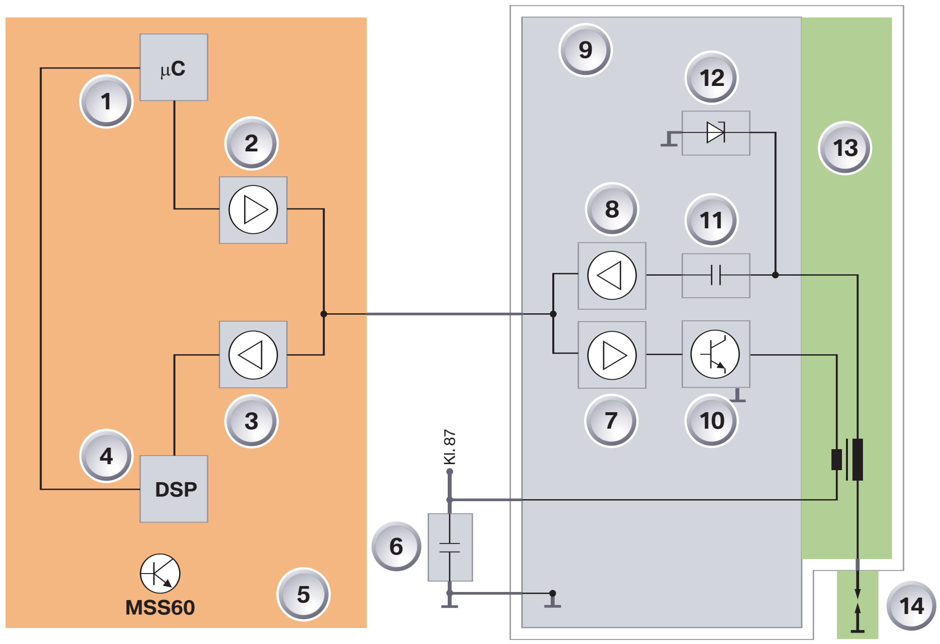
For the purposes of smoothing the voltage and electromagnetic compatibility, an "ignition suppression capacitor" is installed in the wiring harness of each cylinder bank (in the S85 this is in the ion current control device). This is electrically connected using terminal 87 and the vehicle earth.

The same spark plugs are used as in the S85 (basic value approx. 60,000 km).

Note: If the ignition suppression capacitor is defective, this can lead to faults in the communications and/or audio electronics when the engine is running.

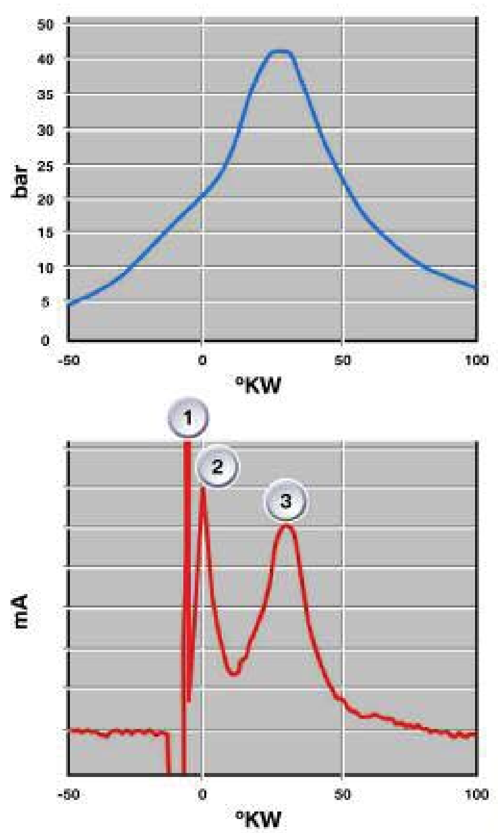
For design reasons, the firing order 1-5-4-8-7-2-6-3 is used in the S65, instead of the firing order 1-5-4-8-6-3-7-2 more commonly employed in BMW V8 engines until now.

Simplified Basic Layout of Ion Current Monitoring



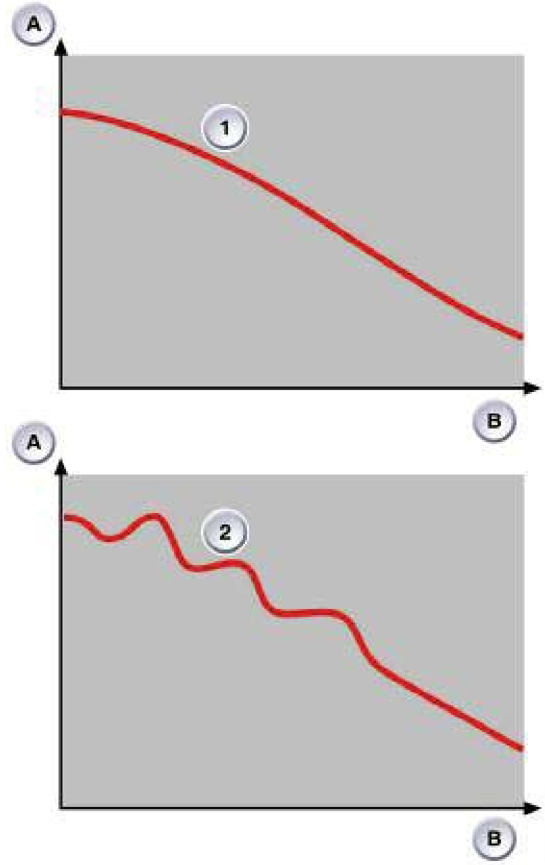
Index	Explanation	Index	Explanation
1	Microcontroller ignition	8	Output amplifier of the ion current measurement signal
2	Output amplifier of the ignition signal	9	Ignition coil with integrated ion current electronics
3	Ion current input amplifier	10	Ignition output stage
4	Digital signal processor for ion current measurement signal	11	Capacitor for storing measured flow
5	MSS60 Engine control system	12	Zener diode for limiting the measured voltage
6	Ignition suppression capacitor (one per cylinder bank for 4 cylinders)	13	Primary and secondary coil
7	Input amplifier for ignition signal	14	Spark plugs

The following diagrams show the ion current curve (bottom) in relation to the development of combustion pressure (top). This curve is used for the evaluation of combustion quality and the identification of misfiring.



Combustion curve (top) and ionic current (bottom)

Index	Explanation
1	Ionic current maximum by induction of ignition coil
2	Ionic current maximum due to ignition (flame front directly in area of spark plugs)
3	The ionic current progression is a function of the pressure curve



MSS60 Representation of normal combustion and combustion knock

Index	Explanation
A	Ionic current (mA)
B	Section of measuring window
1	Normal combustion (no knocking)
2	Combustion knock

Depending on the engine load, the level of the ionic current generated at the spark plug lies in the range 50-500 µA and is only measured by the electronic system in the mA range.

Combustion knock is identified in the ionic current measurement signal in the form of oscillations within a defined measuring window. The measuring window is after position 3 of the above diagram.

NOTES PAGE

Fuel Supply System

A separate control unit is used for the electric fuel pump (EKP-SG). The EKP control signals from the MSS60 are produced via a dedicated CAN bus (LoCAN) (M5: PWM signal). The EKP control unit is made ready for operation by the MSS60 via the input terminal 87. The load current is controlled via a relay at the terminal 30g by CAS3.

In the event of a crash that reaches the relevant threshold value, the MRS5 requests an interrupt to the fuel supply via the K-CAN connection to CAS3.

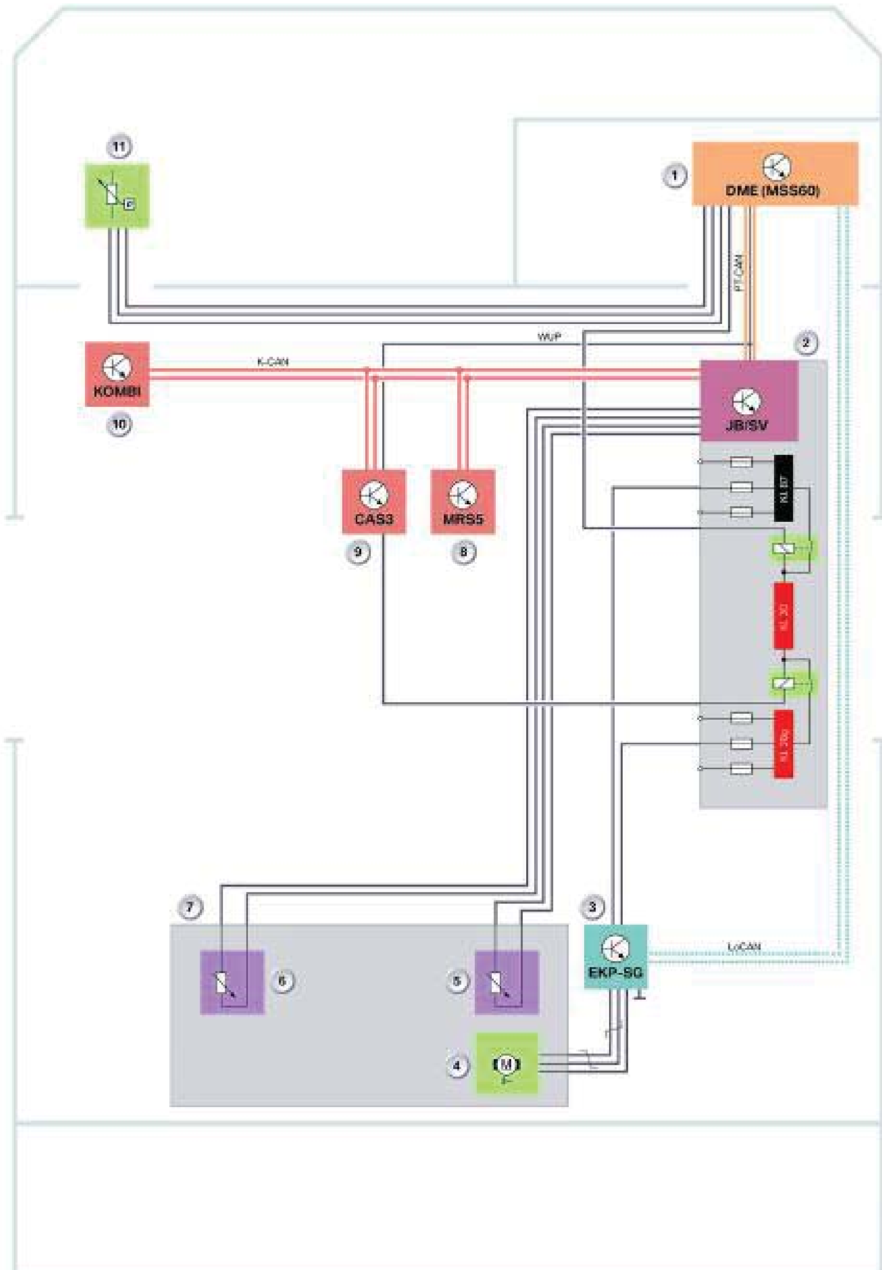
There is now only one fuel pump (the M5 has two). This has a three-phase motor, which ensures sufficient torque across the whole pump speed range. The pump speed is used to provide the required fuel pressure of 3-6 bar, depending on the engine operating state.

A fuel pressure sensor sends its signal to the MSS60. The fuel pressure sensor is located behind the inner fenderwell.

If the pressure sensor fails or there is a fault in the CAN bus and in the engine emergency program, the fuel pump is operated at full speed. In this process, the pressure is limited to 6 bar by the mechanical pressure sensor.

The signals from both tank fill level sensors are sent to the junction box and are forwarded to the instrument cluster via the K-CAN, where they are evaluated and displayed.

MSS60 Fuel Supply System Circuit Diagram



Index	Explanation	Index	Explanation
1	Engine control unit MSS60	7	Fuel tank
2	Junction box	8	Multiple restraint system 5th generation (MRS5)
3	Electric fuel pump control unit	9	Car Access System 3rd generation (CAS3)
4	Fuel pump with three-phase motor	10	Instrument cluster
5	Tank fill level sensor, right	11	Fuel pressure sensor
6	Tank fill level sensor, left		

Cooling System

In the E92 M3, an electric fan is installed (as in the E70), which initially reaches a maximum output of 850 Watts. The fan is activated by the MSS60 via a pulse width-modulated signal (PWM signal) with a frequency of 100-300 Hz for fan operation, wake-up function, and interface diagnosis function.

A frequency of 10 Hz is used for overrun requests.

The signal voltage is approximately the same as the on-board supply voltage. The following cycle ratio specifications (in %) refer to the "low" proportion of the signal period.

The cooling fan power supply is produced using a 100 A high-current circuit breaker in the luggage compartment distributor and a high-voltage relay near the front passenger footwell. The relay is control by terminal 30g (CAS).

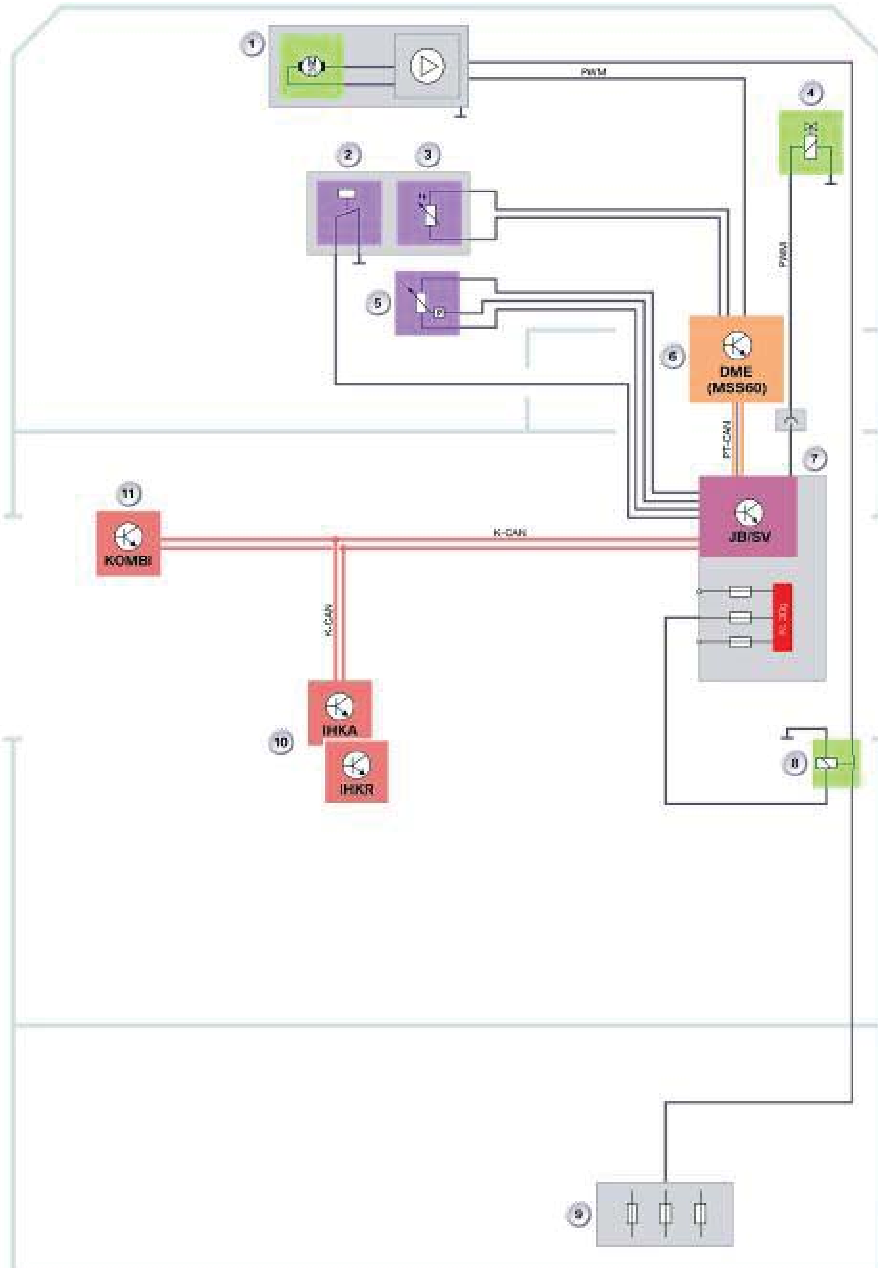
The performance of the cooling fan depends on the coolant temperature, the IHKA request, the intake air temperature, the calculated exhaust gas temperature downstream from the catalytic converter, and the request by the generator (overheating protection).

The control valve in the air conditioning compressor and the coolant pressure sensor are electrically connected to the junction box (JB). The IHKA/IHKR can use the K-CAN connection to evaluate the pressure and send the appropriate control requests for the control valve in the air conditioning compressor to the JB. A resulting load torque for the torque correction and an electric fan speed request are also sent to the MSS60 via the K-CAN.

The junction box only activates the control valve in the air conditioning compressor following release by the MSS60. The MSS60 adapts the idle speed control accordingly and activates the electric fan.

The switching state of the coolant level switch is also transmitted to the junction box and evaluated by the instrument cluster via the K-CAN connection. If there is insufficient coolant, a corresponding warning is sent to the driver.

Cooling System Circuit Diagram



Index	Explanation	Index	Explanation
1	Electric fan (850 W)	7	Junction box
2	Coolant level switch	8	Electric fan relay
3	Coolant temperature sensor	9	High-current circuit breakers
4	Control valve in the air conditioning	10	IHKA
5	Coolant pressure sensor	11	Instrument cluster
6	MSS60 Engine control system		

Function/control of the Electric Fan

Fan Operation
The adjusted fan speed increases in a linear fashion as the cycle ratio increases. The rated speed (n_{Nom}) in the M3 is the same as the maximum number of revolutions (2,400 rpm).

The engine speed of the M3 is controlled in a linear relationship with the cycle ratio (10-91%), starting with 800 rpm (1/3 of n_{Nom}) up to 2,400 rpm.

Note: In the E6x M5/M6 (600 W fan), an additional unregulated increase in engine speed to at least 2,700 rpm (n_{max}) is produced, from a 92% to 95% cycle ratio.

"Wake-up" Function
If they are in sleep mode, the fan electronics can be "woken" by a PWM signal (100-300 Hz) with a cycle ratio of 5-9%. In the E92 M3, in normal operation, the waking is triggered by activation of the terminal 30g with "Ignition ON".

Interface Diagnosis Function

An interface diagnosis is triggered by the MSS60 and used to check the interface. The MSS60 sends a PWM signal (100-300 Hz) for approx. 1 second with a cycle ratio of 96-99%.

If the interface is intact, the fan electronics for confirming the PWM signal cable are set to "low" for 2.5-3 seconds (M5 fan 1-1.5 s).

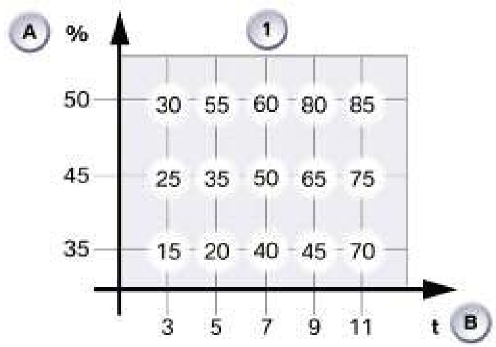
Overrun Request

If an overrun of the fan is required after "Ignition OFF", approximately 7 seconds after "Ignition off", the MSS60 emits a PWM signal with a frequency of 10 Hz for at least 3 seconds. At the issued cycle ratio, the electrical fan system detects at which speed and for what duration the overrun should occur.

The cycle ratio is between 15 and 85% in 5% increments.

It contains the information displayed in the following graphic:

- Engine speeds of 35, 45 or 50% of the rated speed.
- Run-on time of 3-11 minutes in increments of 2 minutes.



Index	Explanation
A	Percentage of rated speed
B	Overrun in minutes
1	Cycle ratio in percent

Fan Self-diagnosis and Fault Signal

The electronic fan system performs an internal diagnosis procedure. If a fault is detected, fan operation is continued as far as possible, if necessary at reduced power.

The following faults lead to a diagnosis message:

- Engine is blocked
- A fault has occurred in the electronic fan system, which means that fan operation is permanently restricted or impossible.

In response to the fault message, the electronic fan system changes the PWM signal to "low" for at least 5, to a maximum of 7 seconds.

Note: A fault message is issued with a delay of approx. one minute, since the electronic fan system first executes a triple internal test cycle.